

mechanism, the circuitry will only determine if the fluid level in any of the receptacle vessels 162 is high, but cannot determine if the fluid level in one of the receptacle vessels is low. In other words, when any of the aspirator tubes 860 and its associated triplet 170 contacts fluid material within a receptacle vessel, capacitance of the system changes due to the change in the dielectric. If the Z-position of the aspirator tubes 860 at which the capacitance change occurs is too high, then a high fluid level in at least one receptacle vessel is indicated, thus implying an aspiration failure. On the other hand, if the Z-position of the aspirator tubes at which the capacitance change occurs is correct, the circuitry cannot differentiate between aspirator tubes, and, therefore, if one or more of the other tubes has not yet contacted the top of the fluid, due to a low fluid level, the low fluid level will go undetected.

Alternatively, the aspirator tube capacitive circuitry can be arranged so that each of the five aspirator tubes 860 operates as an individual level sensing mechanism.

With five individual level sensing mechanisms, the capacitive level sensing circuitry can detect failed fluid aspiration in one or more of the receptacle vessels 162 if the fluid level in one or more of the receptacle vessels is high. Individual capacitive level sensing circuitry can detect failed fluid dispensing into one or more of the receptacle vessels 162 if the fluid level in one or more of the receptacle vessels is low. Furthermore, the capacitive level sensing circuitry can be used for volume verification to determine if the volume in each receptacle vessel 162 is within a prescribed range. Volume verification can be performed by stopping the descent of the aspirator tubes 860 at a position above expected fluid levels, e.g. 110% of expected fluid levels, to make sure none of the receptacle vessels has a level that high, and then stopping the descent of the aspirator tubes 860 at a position below the expected fluid levels, e.g. 90% of expected fluid levels, to make sure that each of the receptacle vessels has a fluid level at least that high.

Following aspiration, the aspirator tubes 860 are raised, the magnet moving structure 810 is lowered, and a prescribed volume of wash buffer is dispensed into each receptacle vessel 162 of the MTU 160 through the wash buffer dispenser nozzles 858. To prevent hanging drops of wash buffer on the wash buffer dispenser nozzles 858, a brief, post-dispensing air aspiration is preferred.

The orbital mixer assembly 828 then moves the MTU carriers 820 in a horizontal orbital path at high frequency to mix the contents of the MTU 160. Mixing by moving, or agitating, the MTU in a horizontal plane is preferred so as to avoid splashing the fluid contents of the MTU

and to avoid the creation of aerosols. Following mixing, the orbital mixer assembly 828 stops the MTU carrier unit 820 at the fluid transfer position.

To further purify the targeted nucleic acids, the magnet moving structure 810 is again raised and maintained in the raised position for a prescribed dwell period. After magnetic dwell, the aspirator tubes 860 with the engaged tiptlets 170 are lowered to the bottoms of the receptacle vessels 162 of the MTU 160 to aspirate the test specimen fluid and wash buffer in an aspiration procedure essentially the same as that described above.

One or more additional wash cycles, each comprising a dispense, mix, magnetic dwell, and aspirate sequence, may be performed as defined by the assay protocol. Those skilled in the art of nucleic acid-based diagnostic testing will be able to determine the appropriate magnetic dwell times, number of wash cycles, wash buffers, etc. for a desired target capture procedure.

While the number of magnetic separation wash stations 800 can vary, depending on the desired throughput, analyzer 50 preferably includes five magnetic separation wash stations 800, so that a magnetic separation wash procedure can be performed on five different MTUs in parallel.

After the final wash step, the magnet moving structure 810 is moved to the down position and the MTU 160 is removed from the magnetic separation wash station 800 by the left-side transport mechanism 502 and is then placed into the left orbital mixer 552.

After the MTU 160 is removed from the wash station, the tiptlets 170 are stripped from the aspiration tubes 860 by a stripper plate 872 located at the bottom of the lower section 803 of the housing 802.

The stripper plate 872 has a number of aligned stripping holes 871 corresponding in number to the number of aspiration tubes 860, which is five in the preferred embodiment. As shown in FIGURES 29A to 29D, each stripping hole 871 includes a first portion 873, a second portion 875 smaller than first portion 873, and a bevel 877 surrounding portions 873 and 875. The stripper plate 872 is oriented in the bottom of the housing 802 so that the small portion 875 of each stripping hole 871 is generally aligned with each associated aspiration tube 860, as shown in FIGURE 29A. The aspiration tubes 860 are lowered so that the tiptlet 170 at the end of each aspirator tube 860 engages the stripping hole 871. Small portion 875 is too small to accommodate the diameter of a tiptlet 170, so the bevel 877 directs the tiptlet 170 and the aspirator tube 860 toward the larger portion 873, as shown in FIGURE 29B. The aspirator tubes 860 are made of an elastically flexible material, preferably stainless steel, so that, as the aspirator

tubes 860 continue to descend, the beveled portion 877 causes each of aspirator tubes 860 to deflect laterally. The small portion 875 of the stripping hole 871 can accommodate the diameter of the aspirator tube 860, so that after the rim 177 of the triplet 170 clears the bottom of stripping hole 871, each of the aspirator tubes 860 snaps, due to its own resilience, into the small portion 875 of the stripping hole 871 as shown in FIGURE 29C. The aspirator tubes 860 are then raised, and the rim 177 of each triplet 170 engages the bottom peripheral edge of the small portion 875 of stripping hole 871. As the aspirator tubes 860 ascend further, the triplets 170 are pulled off the aspirator tubes 860 by the stripping holes 871 (see FIGURE 29D). The stripped triplets 170 are directed by a chute into a solid waste container, such as the triplet waste bin 1134.

The capacitance of the aspiration tubes 860 is sampled to verify that all triplets 170 have been stripped and discarded. The stripping step can be repeated if necessary.

An alternate stripper plate 882 is shown in FIGURES 31A to 31C. Stripper plate 882 includes a number of stripping holes 881 corresponding to the number of aspirator tubes 860, which is five in the preferred embodiment. Each stripping hole 881 includes a through-hole 883 surrounded by a bevelled countersink 887. A pair of tangs 885 extend laterally from diametrically opposed positions below the through-hole 883. Tangs 885 are preferably made from a spring steel and include a v-notch 886 at their ends.

As an aspirator tube 860 with a triplet 170 disposed on its end is lowered toward stripping hole 881, bevelled portion 887 ensures that any misaligned tubes are directed into the through-hole 883. The spacing between the ends of the opposed tangs 885 is less than the diameter of the triplet 170, so as the aspirator tube 860 and triplet 170 are lowered, the triplet engages the tangs 885, causing them to deflect downwardly as the triplet 170 is forced between tangs 885. When the aspirator tubes 860 are raised, the notches 886 of the tangs 885 grip the relatively soft material of the triplet 170, thus preventing upward relative movement of the triplet 170 with respect to the tangs 885. As the tubes continue to ascend, the tangs 885 pull the triplet 170 off the tube 860. When the aspirator tubes 860 are subsequently lowered to strip a subsequent set of triplets, the triplet held between the tangs from the previous stripping is pushed through the tangs by the next triplet and is directed toward waste bin 1134 (see FIGURE 52) located in the lower chassis 1100 generally below the five magnetic separation wash stations 800.

Still another alternate, and the presently preferred, stripper plate 1400 is shown in FIGURES 30A-30D. Stripper plate 1400 includes five stripper cavities 1402, each including an initial frusto-conical portion 1404. The frusto-conical portion 1404 tapers down to a neck